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that does not stimulate adenosine A<sub>1</sub>, A<sub>2b</sub> or A<sub>3</sub> receptors, but which may stimulate adenosine A<sub>2a</sub> receptors. In this manner, a specific adenosine receptor gene may be targeted to obtain one or more anti-sense oligonucleotide(s) (oligos) that selectively bind(s) to the corresponding mRNA, and then, if necessary, their content of adenosine may be reduced by substituting one or more universal bases or adenosine analogues incapable of activating adenosine A<sub>1</sub>, A<sub>2b</sub> or A<sub>3</sub> receptors or which activate the adenosine A<sub>2a</sub> receptor. Thus, in addition to "down-regulating" specific adenosine receptor genes, the present oligos have an increased effect when administered by either selection of genes, RNA and flanking regions that are devoid, or have a low [A] T/U content, or alternatively one or more of the adenosine(s) present in the antisense oligonucleotide(s) are substituted with other nucleotide bases, so called universal bases, which bind to thymidine (T) but lack the ability to activate adenosine receptors and otherwise may not activate adenosine receptors. Given that adenosine (A) is a nucleotide base complementary to thymidine (T) and uridine (U), when a T appears in the DNA or a U in the RNA target, the anti-sense oligo will have an A at the same position.

#### **THE SEQUENCE LISTING**

Please ignore the Sequence Listing section filed May 4, 2000, and substitute therefore the one filed March 22, 2001.

#### **IN THE CLAIMS**

Please delete claim 175, and amend the remaining claims as shown in the enclosures.

#### **REMARKS**

#### **THE INTERVIEW**

Dr. Epps is hereby thanked for several telephonic conferences held since the interview of March 22, 2001, including the one held earlier today, which produced a final agreement in relation to claim language, the amendments to the specification and the Sequence Listing. Such agreement is reflected in the attached substitute pages.

#### **THE PENDING CLAIMS**

Claims 108-131, 133-134, 146, 148, 151-156, 158-159, 161-173, 178-

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181, 183-189, 191-193, 195-198 and 200-234 are pending in this case, and no claims are being amended hereby.

### **THE SPECIFICATION**

The present amendments are necessary due to typographical/clerical errors incurred at the time of filing at page 37 and original claim 89. From the context, it may be surmised that in order for an anti-sense oligonucleotide to have an adenosine (A) base at a specific site, the target nucleic acid must have at the site a thymidine (T) if it is DNA, or a uridine (U) if it is RNA.

Further support for these amendments may be found in the same paragraph bridging pages 37 and 38, in the definition of universal bases that are provided to be substituted for adenosine (A) in the anti-sense oligonucleotide. These universal bases are said to "bind to thymidine (T) but lack the ability to activate adenosine receptors and otherwise may not activate adenosine receptors."

The applicant requests consideration of the present amendments to the specification and is providing substitute page 38 for printing purposes.

### **THE SEQUENCE LISTING**

A Substitute Sequence Listing and a Declaration have been provided to the examiner, who is requested to substitute it for that filed May 4, 2000.

### **THE CLAIMS**

The claims have been amended as agreed to during the interview and, therefore, believed to be in allowable form. In particular, claims 164, 173, 185-187 and 200-222, have been amended solely by addition of "adenosine receptors", as supported throughout the specification, (e.g. page 7, paragraph starting at line 10, showing the effect of the oligo on the adenosine A1 receptor; page 8, paragraph starting at line 23; page 9, paragraph starting at line 11; page 10, lines 14-17 of the substitute specification), the drawings (e. g. Figures 1 and 2), and other already examined claims such as claim 179. By means of example, the following text appears in the substitute specification at page 49, 1<sup>st</sup>. paragraph of Example 1 reads as follows:

The design of anti-sense oligonucleotides against the

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adenosine receptors is based on the primary and secondary structure of the target receptor mRNA. The anti-sense oligonucleotides are selected, and optimally modified, to target regions of mRNA which confer functional activity r stability to the mRNA and which preferably may overlap the initiation codon.

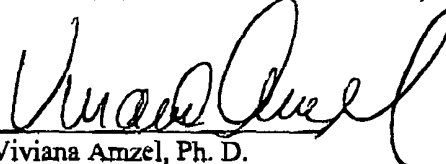
Claim 200 has been amended as supported by the specification as filed and the original claims. No new matter is believed to be present in the pending claims. Therefore, the applicant believes they are in condition for allowance.

**GENERAL REMARKS**

The Assistant Commissioner is hereby authorized to charge \$55.- for a first month extension of time, and any other fees owed, or refund any excess, to PTO Deposit Account No. 50-1728, including a fee for an extension of time which, if needed, is hereby requested.

In view of the foregoing amendments and remarks, and of the prior filing of a Substitute Sequence Listing and Declaration, as well as a Petition for Extension of Time and a Notice of Appeal with payment of the requisite fees, this application is believed to be in condition for examination and allowance. Early notice to this respect is solicited.

Respectfully submitted,  
EPIGENESIS PHARMACEUTICALS, INC



Viviana Amzel, Ph. D.  
Reg. No. 30930  
Attorney for the Applicant

July 12, 2001  
Date

7 Clarke Drive  
Cranbury, NJ 08512  
609-409-3035 Ph.  
413-845-7530 Fax  
Vamzel@epigene.com

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108. A pharmaceutical composition comprising [.] a carrier; a nucleic acid in the form of an aerosol that comprises one or more oligonucleotide(s) (oligo(s)) effective to alleviate hyper-responsiveness to, and/or increased levels of, adenosine, bronchoconstriction, allergy(ies) and/or inflammation, and contains up to and including about 15% adenosine (A), the oligo being anti-sense to an initiation codon, a coding region or a 5' or 3' intron-exon junctions of a gene encoding an adenosine A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> receptor or anti-sense to their respective mRNA; pharmaceutically and veterinarily acceptable salts of the oligo(s) or mixtures thereof; and a surfactant that may be operatively linked to the nucleic acid.

109. The composition of claim 108, wherein the oligo consists of up to about 10% A.

110. The composition of claim 109, wherein the oligo consists of up to about 5% A.

111. The composition of claim 110, wherein the oligo consists of up to about 3% A.

112. The composition of claim 111, wherein the oligo is A-free.

113. The composition of claim 108, wherein the oligo is anti-sense to the initiation codon of the mRNA, to the 5' or 3' intron-exon junctions or to sequences of the coding region comprising 2 or more G and/or C of the adenosine A<sub>1</sub> receptor gene.

114. The composition of claim 108, wherein the oligo is anti-sense to the initiation codon of the mRNA, to the 5' or 3' intron-exon junctions or to sequences of the coding region comprising 2 or more G and/or C of the adenosine A<sub>2a</sub>, A<sub>2b</sub> and/or A<sub>3</sub> receptors.

115. The composition of claim 108, wherein if the oligo contains adenosine (A), at least one A is substituted by a universal base selected from [the group consisting of] heteroaromatic bases which bind to a thymidine base but have antagonist activity [and] or less than about 0.3 of the adenosine base agonist activity at the adenosine A<sub>1</sub>, A<sub>2b</sub> [and] or A<sub>3</sub> receptors, [and] or heteroaromatic bases [which] that have no activity or have [an] agonist activity at the adenosine A<sub>2a</sub> receptor.

116. The composition of claim 115, wherein substantially all As are substituted by a universal base (s) selected from heteroaromatic bases that bind to a thymidine base but either have antagonist activity or less than about 0.3 of the adenosine base agonist activity at the adenosine A<sub>1</sub>, A<sub>2b</sub> [and] or A<sub>3</sub> receptors, or heteroaromatic bases that have no activity or have agonist activity at the adenosine A<sub>2a</sub> receptor.

117. The composition of claim 115, wherein the heteroaromatic bases are selected from pyrimidines or purines that may be substituted by O, halo, NH<sub>2</sub>, SH, SO, SO<sub>2</sub>, SO<sub>3</sub>, COOH, or branched or fused primary or secondary amino, alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkoxy, alkenoxy, acyl, cycloacyl, arylacyl, alkynoxy, cycloalkoxy, aroyl, arylthio, arylsulfoxyl, halocycloalkyl, alkylcycloalkyl, alkenylcycloalkyl,

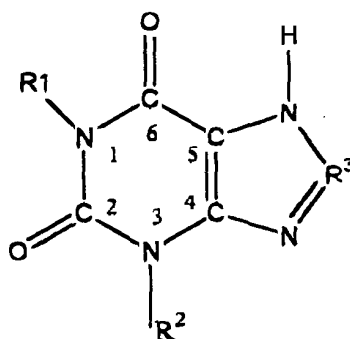
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alkynylcycloalkyl, haloaryl, alkylaryl, alkenylaryl, alkynylaryl, arylalkyl, arylalkenyl, arylalkynyl, or arylcycloalkyl, all of which may be further substituted by O, halo, NH<sub>2</sub>, primary, secondary or tertiary amine, SH, SO, SO<sub>2</sub>, SO<sub>3</sub>, cycloalkyl, heterocycloalkyl or heteroaryl.

118. The composition of claim 117, wherein the pyrimidines are substituted at a 1, 2, 3, and/or 4 position, and the purines are substituted at a 1, 2, 3, 4, 7 and/or 8 position.

119. The composition of claim 118, wherein the pyrimidines or purines are selected from theophylline, caffeine, dyphylline, etophylline, acephylline piperazine, bamifylline, enprofylline or xantine having the chemical formula



wherein R<sup>1</sup> and R<sup>2</sup> are independently H, alkyl, alkenyl or alkynyl and R<sup>3</sup> is H, aryl, dicycloalkyl, dicycloalkenyl, dicycloalkynyl, cycloalkyl, cycloalkenyl, cycloalkynyl, O-cycloalkyl, O-cycloalkenyl, O-cycloalkynyl, NH<sub>2</sub>-alkylamino-ketoxyalkyloxy-aryl or mono or dialkylaminoalkyl-N-alkylamino-SO<sub>2</sub> aryl.

120. The composition of claim 116, wherein the universal base is selected from 3 - nitropyrrole - 2' - deoxynucleoside, 5 -nitroindole, 2 - deoxyribosyl - (5- nitroindole), 2 - deoxyribofuranosyl - ( 5 - nitroindole), 2' - deoxyinosine, 2' - deoxynebularine, 6H, 8H - 3, 4 - dihydropyrimido [4, 5 - c] oxazine - 7 - one or 2 - amino - 6 - methoxyaminopurine.

121. The composition of claim 108, wherein a methylated cytosine (mC) is substituted for an unmethylated cytosine (C) in at least one CpG dinucleotide if present in the nucleic acid(s).

122. The composition of claim 108, wherein at least one mononucleotide is linked or modified by one or more of phosphorothioate, phosphorodithioate, phosphorotrithioate, methylphosphonate, phosphoramidate, boranophosphate, phosphotriester, formacetal, 2'-O-methyl, thioformacetal, 5'-thioether, carbonate, 5'-N-carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene (methylimino) (MMI) and methyleneoxy (methylimino) (MOMI), terminal 1,3-propanediol, terminal dodecanol, 2'-O-methoxyethyl, C-5-propynyl pyrimidine, C-5 methyl cytidine, C-5 ethynyl pyrimidine, 2'-

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propoxy, C-18 amine, N3'-P5' phosphoramidates, 3'-alkylamino, 2'-fluoro; 5-fluoro pyrimidine, 5-iodo pyrimidine, 5-bromo pyrimidine, 2'-borano, C-5 hexynyl pyrimidine, 2'-O-(2-methoxy)ethyl, 2'-O-aminopropyl, 5-(phenylethyl) or peptide nucleic acid interbase linkages or conjugated to a polyethylene glycol, cholesterol, cholesteryl, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEASulfate), dehydroepiandrosterone sulfatide (DHEA Sulfatide), ubiquinone (CoQn), dolichol, poly L-lysine, sulfatidic acid or fatty acids.

123. The composition of claim 122, wherein substantially all mononucleotides are linked or modified by one or more of phosphorothioate, phosphorodithioate, phosphorotrithioate, methylphosphonate, phosphoramidate, boranophosphate, phosphotriester, formacetal, 2'-O-methyl, thioformacetal, 5'-thioether, carbonate, 5'-N-carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene (methylimino) (MMI) and methyleneoxy (methylimino) (MOMI), terminal 1,3-propanediol, terminal dodecanol, 2'-O-methoxyethyl, C-5-propynyl pyrimidine, C-5 methyl cytidine, C-5 ethynyl pyrimidine, 2'-propoxy, C-18 amine, N3'-P5' phosphoramidates, 3'-alkylamino, 2'-fluoro; 5-fluoro pyrimidine, 5-iodo pyrimidine, 5-bromo pyrimidine, 2'-borano, C-5 hexynyl pyrimidine, 2'-O-(2-methoxy)ethyl, 2'-O-aminopropyl, 5-(phenylethyl) or peptide nucleic acid interbase linkages or conjugated to a polyethylene glycol, cholesterol, cholesteryl, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEASulfate), dehydroepiandrosterone sulfatide (DHEA Sulfatide), ubiquinone (CoQn), dolichol, poly L-lysine, sulfatidic acid or fatty acids.

124. The composition of claim 108, wherein the [anri-sense] oligo comprises about 7 to about 60 mononucleotides.

125. The composition of claim 108, wherein the oligo comprises [a sequence selected from] SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5 or SEQ ID NO: 7 to SEQ ID NO: 966, or SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5 or SEQ ID NO: 7 to SEQ ID NO: 966, wherein at least one mononucleotide is linked or modified by one or more of phosphorothioate, phosphorodithioate, phosphorotrithioate, methylphosphonate, phosphoramidate, boranophosphate, phosphotriester, formacetal, 2'-O-methyl, thioformacetal, 5'-thioether, carbonate, 5'-N-carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene (methylimino) (MMI) and methyleneoxy (methylimino) (MOMI), terminal 1,3-propanediol, terminal dodecanol, 2'-O-methoxyethyl, C-5-propynyl pyrimidine, C-5 methyl cytidine, C-5 ethynyl pyrimidine, 2'-propoxy, C-18 amine, N3'-P5' phosphoramidates, 3'-alkylamino, 2'-fluoro; 5-fluoro pyrimidine, 5-iodo pyrimidine, 5-bromo pyrimidine, 2'-borano, C-5 hexynyl pyrimidine, 2'-O-(2-methoxy)ethyl, 2'-O-aminopropyl, 5-(phenylethyl) or peptide nucleic acid interbase linkages or conjugated to a polyethylene glycol,

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cholesterol, cholesteryl, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEA Sulfate), dehydroepiandrosterone sulfatide (DHEA Sulfatide), ubiquinone (CoQn), dolichol, poly L-lysine, sulfatidic acid or fatty acids.

126. The composition of claim 108, wherein the nucleic acid is linked to an agent that enhances cell internalization or up-take and/or a cell targeting agent.

127. The composition of claim 126, wherein the cell internalization or up take enhancing agent is a transferrin, a asialoglycoprotein or a streptavidin.

128. The composition of claim 126, wherein the cell targeting agent comprises a vector, and the nucleic acid is operatively linked to the vector.

129. The composition of claim 128, wherein the vector comprises a prokaryotic or eukaryotic vector.

130. The composition of claim 108, wherein the surfactant is selected from surfactant protein A, surfactant protein B, surfactant protein C, surfactant protein D, [and] surfactant protein D or active fragments thereof, non-dipalmitoyl disaturated phosphatidylcholine, dipalmitoylphosphatidylcholine, phosphatidylcholine, phosphatidylglycerol, phosphatidylinositol, phosphatidylethanolamine, phosphatidylserine, phosphatidic acid, ubiquinones, lysophosphatidylethanolamine, lysophosphatidylcholine, palmitoyl-lysophosphatidylcholin, dehydroepiandrosterone, dolichols, sulfatidic acid, glycerol-3-phosphate, dihydroxyacetone phosphate, glycerol, glycerol-3-phosphocholine, dihydroxyacetone, palmitate, cytidine diphosphate (CDP) diacylglycerol, CDP choline, choline, choline phosphate, lamellar bodies, omega-3 fatty acids, polyenic acid, polyenoic acid, lecithin, palmitic acid, non-ionic ethylene and/or propylene oxide block copolymers, polyoxypropylene, polyoxyethylene, poly (vinyl amine) with dextran and/or alkanoyl side chains, polyoxy ethylene ethers, phenoxy polyethoxy alcohols, phosphatidyl choline esters, [and] phosphatidyl ethers, palmitates, [alcohols] tyloxapol, phospholipids, [neutral lipids,] fatty acids, [or] surfactant-associated proteins or  $C_{22}H_{19}C_{10}$

131. The composition of claim 130, wherein the surfactant is selected from polyoxy ethylene 23 lauryl ether (Brij 35<sup>®</sup>), t-octyl phenoxy polyethoxy ethanol (Triton X-100<sup>®</sup>), dipalmitoyl phosphatidyl choline (DPPC) and phosphatidyl glycerol (PG) (ALEC<sup>®</sup>), tyloxapol (Exosurf<sup>®</sup>), phospholipids, fatty acids, surfactant-associated proteins (Survanta<sup>®</sup>) or  $C_{22}H_{19}C_{10}$  (Atovaquone<sup>®</sup>).

133. The composition of claim 108, wherein the carrier comprises a biologically acceptable carrier.

134. The composition of claim 108, wherein the carrier is a pharmaceutically or

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veterinarily acceptable carrier.

135. The composition of claim 134, wherein the carrier is selected from gaseous, liquid or solid carriers.

136. The composition of claim 108, further comprising an agent selected from therapeutic agents other than the nucleic acid(s), antioxidants, flavoring or coloring agents, fillers, volatile oils, buffering agents, dispersants, RNA inactivating agents, flavoring agents, propellants or preservatives.

137. The composition of claim 136, comprising a pharmaceutically or veterinarily acceptable carrier, the nucleic acid, a surfactant, and other therapeutic agents [a therapeutic agent selected from adenosine A1, A2b or A3 receptor activity inhibiting agents other than the oligo(s), anti-arrhythmic agents, anti-inflammatory agents, anti-bacterial agents, anti-sepsis agents, adenosine or agents exhibiting adenosine agonist activity, analgesics, diuretics, kidney activity maintenance or restoration agents or agents for the treatment of pulmonary vasoconstriction, inflammation, allergies, asthma, acute respiratory distress syndrome (ARDS), ischemia, impeded and blocked respiration, respiratory distress syndrome (RDS), pain, cystic fibrosis (CF), pulmonary hypertension, pulmonary vasoconstriction, emphysema, chronic obstructive pulmonary disease (COPD)].

138. The composition of claim 136, wherein the RNA inactivating agent comprises an enzyme.

139. The composition of claim 138, wherein the enzyme comprises a ribozyme.

140. The composition of claim 108, further comprising a propellant.

141. The composition of claim 108, wherein the nucleic acid is present in an amount of about 0.01 to about 99.99 w/w of the composition.

143. The formulation of claim 108, selected from intrabuccal, intrapulmonary, respirable, nasal, inhalable, intracavitary, intraorgan, or slow release formulations.

144. The formulation of claim 143, wherein the carrier is selected from a gaseous, solid or liquid carrier.

146. The aerosol or spray formulation of claim 108, [wherein] which is selected from powders, sprays, solutions, suspensions or emulsions.

148. The aerosol or spray formulation of claim 108, which is selected from aqueous or alcoholic solutions or suspensions, oily solutions or suspensions, or oil-in-water or water-in-oil emulsions.

151. A capsule or cartridge, comprising the formulation of claim 143.



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152. The spray or aerosol formulation of claim 146, comprising a solid powdered spray or aerosol.

153. The formulation of claim 108, wherein the carrier comprises a hydrophobic carrier.

154. The formulation of claim 153, wherein the carrier comprises lipid vesicles and/or particles.

155. The formulation of claim 154, wherein the vesicles comprise liposomes, and the particles comprise microcrystals.

156. The formulation of claim 155, wherein the vesicles comprise liposomes that comprise the nucleic acid.

158. The formulation of claim 143, which comprises an intrapulmonary, intracavitary or intraorgan liquid or solid powdered formulation of particle size about 0.5 $\mu$  to about 10  $\mu$ , or about 10  $\mu$  to about 500  $\mu$ .

159. The formulation of claim 143, which comprises a nasal formulation of particle size about 10  $\mu$  to about 500  $\mu$ .

161. The formulation of claim 143, in bulk, or in single or multiple unit dose form.

162. The formulation of claim 143, which is a respirable or inhalable formulation [of] comprising a solid powdered or liquid aerosol or spray of particle size about 0.5  $\mu$  to about 10  $\mu$ .

163. A single cell, comprising the nucleic acid of claim 108.

164. A kit for diagnosis or treatment of diseases and conditions associated with hypersensitivity to and/or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors and/or bronchoconstriction and/or lung allergy(ies) and/or inflammation and/or asthma comprising, in separate containers,

the delivery device of claim 222;

a nucleic acid comprising at least one oligonucleotide (oligo) effective to alleviate hyper-responsiveness to, and/or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, or to alleviate bronchoconstriction, asthma or lung allergy(ies) and/or inflammation, the oligo being anti-sense to the initiation codon, the coding region or the 5' or 3' intron-exon junctions of a gene encoding a protein associated with hyper-responsiveness to, and/or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, with bronchoconstriction, asthma, or lung allergy(ies) or inflammation, or being anti-sense to the corresponding mRNA; the nucleic acid comprising one or more oligo(s), their mixtures or their pharmaceutically or veterinarily acceptable salts [of the oligo(s)]; and

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instructions for preparation of a respirable, inhalable, nasal, intrapulmonary, intraorgan, or intracavitary formulation of particle size about 0.5 to about 500  $\mu$  and for its use; and optionally an agent selected from therapeutic or diagnostic agents other than the oligo, anti-oxidants, fillers, volatile oils, dispersants, anti-oxidants, flavoring agents, propellants, preservatives, solvents, buffering agents, RNA inactivating agents, agents that are internalized or up-taken by a cell, or coloring agents.

165. The kit of claim 164, wherein the delivery device comprises a nebulizer that delivers single metered doses of a solid powdered or liquid aerosol or spray formulation of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$  of the nucleic acid.

166. The kit of claim 164, wherein the device comprises an insufflator adapted for receiving and piercing or opening a capsule(s) or cartridge(s) and producing a solid powdered or liquid aerosol or spray; and the nucleic acid is provided separately in a pierceable or openable capsule(s) or cartridge(s) as a nasal, inhalable, respirable, intrapulmonary, intracavitary or intraorgan formulation of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ .

167. The kit of claim 164, wherein the delivery device comprises a pressurized [inhalator] inhaler that delivers a solid powdered or liquid aerosol or spray of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ ; and the nucleic acid is provided as a suspension, solution, emulsion or dry powder aerosol or spray formulation of about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ .

168. The kit of claim 164, comprising the delivery device, a surfactant, the nucleic acid and other therapeutic agents [a therapeutic agent selected from adenosine A1, A2b or A3 receptor antagonists other than the oligo(s), adenosine A2a receptor stimulants, anti-inflammatory agents, anti-histaminic agents, anti-allergic agents, anti-bacterial, anti-virals, analgesics, kidney activity maintenance or restoration agents, anti-cancer agents, adenosine, blood pressure controlling agents, or diuretics].

169. The kit of claim 164, wherein the solvent is selected from organic solvents or organic solvents mixed with one or more co-solvents.

170. The kit of claim 164, wherein the device is adapted for receiving a capsule(s) or cartridge(s), and the nucleic acid is separately provided as an inhalable, respirable, nasal, intracavitary, intraorgan or intrapulmonary formulation in a capsule(s) or cartridge(s).

171. The kit of claim 164 further comprising, in [a] separate containers, a propellant, and pressurized means for delivery adapted for delivering a solid powdered or liquid aerosol or spray, and instructions for loading into the delivery device [the nucleic acid as] an inhalable, respirable, nasal, intracavitary, intraorgan or intrapulmonary formulation of the nucleic

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acid of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ , and then joining the device with the propellant and the pressurized means.

172. The kit of claim 167, wherein the pressurized [inhalator] inhaler further comprises a propellant and means for delivery of the propellant, and delivers the nucleic acid as a liquid or solid powdered aerosol or spray formulation [of the nucleic acid].

173. An in vivo method of delivering a pharmaceutical composition to a target polynucleotide, comprising administering to the airways of a subject an aerosol or spray composition of particle size about 0.5  $\mu$  to about 500  $\mu$  [,] comprising a nucleic acid which comprises at least one oligonucleotide (oligo) effective to alleviate hyper-responsiveness to, and/or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, or to alleviate bronchoconstriction, asthma and/or lung allergy(ies) and/or inflammation, the oligo containing up to and including about 15% adenosine (A), and being anti-sense to the initiation codon, the coding region or the 5' or 3' intron-exon junctions of a gene encoding a protein associated with hyper-responsiveness to, and/or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [with] bronchoconstriction, asthma [,] and/or lung allergy(ies) and/or inflammation, or being anti-sense to the corresponding mRNA; the nucleic acid comprising one or more oligo(s), pharmaceutically [and] or veterinarily acceptable salts of the oligo(s), or mixtures of the oligo(s) or their salts.

178. The method of claim 173, wherein the composition is administered intrapulmonarily, intraorgan, intracavitarily, intrabuccally, intranasally, by inhalation or into the subject's respiratory system.

179. The method of claim 173, wherein the oligo is effective to reduce hyper-responsiveness to adenosine, the amount of the adenosine receptor or the production or availability of adenosine, or to increase the degradation of the adenosine receptor mRNA.

180. The method of claim 178, wherein the oligo is administered directly into the subject's lung (s), intraorgan, intracavitarily, intrabuccal or intrapulmonarily.

181. The method of claim 178, wherein the composition is administered as [powdered] solid powdered or liquid particles of the nucleic acid about 0.5 to about 10  $\mu$  in size.

183. The method of claim 181, wherein the composition is administered as [powdered] solid powdered or liquid nucleic acid particles less than about 5  $\mu$  or greater than about 10  $\mu$  in size.

184. The method of claim 173, wherein the composition further comprises a surfactant.

185. The method of claim 173, wherein the hyper-responsiveness to, and/or increased

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levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [or bronchoconstriction] asthma or lung allergy(ies) or inflammation is associated with bronchoconstriction of lung airways.

186. The method of claim 185, wherein the hyper-responsiveness to, or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [or] bronchoconstriction, asthma or lung allergy(ies) or inflammation is associated with COPD, asthma, ARDS, RDS, CF or side effects of adenosine administration.

187. The method of claim 173, wherein the hyper-responsiveness to, or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [or] bronchoconstriction, asthma, or lung allergy(ies) or inflammation is associated with inflammation or an inflammatory disease.

188. The method of claim 173, wherein the composition further comprises other therapeutic agents

[a therapeutic agent selected from adenosine A<sub>1</sub>, A<sub>2b</sub> or A<sub>3</sub> receptor inhibiting agents or adenosine A<sub>2a</sub> receptor stimulating agents other than the nucleic acid(s); anti-inflammatory agents, anti-bacterial agents, anti-sepsis agents, kidney activity maintenance or restoration agents or agents for the treatment of pulmonary vasoconstriction, inflammation, allergies, asthma, impeded respiration, respiratory distress syndrome (RDS), acute respiratory distress syndrome (ARDS), pain, cystic fibrosis (CF), pulmonary hypertension, pulmonary vasoconstriction, emphysema, or chronic obstructive pulmonary disease (COPD)].

189. The method of claim 188, wherein the therapeutic agent [is selected from] comprises anti-adenosine A<sub>1</sub>, A<sub>2b</sub> or A<sub>3</sub> receptor agents or adenosine A<sub>2a</sub> receptor stimulating agents other than the nucleic acid(s).

191. The method of claim 184, wherein the surfactant comprises surfactant protein A, surfactant protein B, surfactant protein C, surfactant protein D or active fragments thereof, non-dipalmitoyl disaturated phosphatidylcholine, dipalmitoylphosphatidylcholine, phosphatidylcholine, phosphatidylglycerol, phosphatidylinositol, phosphatidylethanolamine, phosphatidylserine, phosphatidic acid, ubiquinones, lysophosphatidylethanolamine, lysophosphatidylcholine, palmitoyl-lysophosphatidylcholin, dehydroepiandrosterone, dolichols, sulfatidic acid, glycerol-3-phosphate, dihydroxyacetone phosphate, glycerol, glycerol-3-phosphocholine, dihydroxyacetone, palmitate, cytidine diphosphate (CDP) diacylglycerol, CDP choline, choline, choline phosphate, lamellar bodies, omega-3 fatty acids, polyenic acid, polyenoic acid, lecithin, palmitic acid, non-ionic ethylene and/or propylene oxide block copolymers, polyoxypropylene, polyoxyethylene, poly (vinyl amine) with dextran and/or alkanoyl side chains, polyoxy ethylene ethers, phenoxy polyethoxy alcohols, phosphatidyl choline esters, [and] phosphatidyl ethers, palmitates, alcohols and tyloxapol, phospholipids, fatty

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acids, [or] surfactant-associated proteins, [and] or  $C_{22}H_{19}C_{10}$ .

192. The method of claim 173, wherein the subject is a mammal.

193. The method of claim 192, wherein the mammal is a human or a non-human mammal.

195. The method of claim 173, wherein the nucleic acid is administered in amount of about 0.005 to about 150 mg/kg body weight.

196. The method of claim 195, wherein the nucleic acid is administered in an amount of about 0.01 to about 75 mg/kg body weight.

197. The method of claim 196, wherein the nucleic acid is administered in an amount of about 1 to about 50 mg/kg body weight.

198. The method of claim 173, which is a prophylactic or therapeutic method.

200. The method of claim 173, wherein the nucleic acid is obtained by

(a) selecting fragments of a target nucleic acid having at least 4 contiguous bases consisting of G or C; and

[(b) obtaining a first oligo 4 to 60 nucleotides long which comprises the selected fragment and has a [C and G ~~base~~] nucleic acid content of up to and including about 15%; and (c)]

(b) obtaining a second oligo 4 to 60 nucleotides long comprising a sequence [which] that is anti-sense to the selected fragment, the second oligo having an A base content of up to and including about 15%.

201. The method of claim 173, wherein the oligo consists of up to about 10% A.

202. The method of claim 201, wherein the oligo consists of up to about 5% A.

203. The method of claim 201, wherein the oligo consists of up to about 3% A.

204. The method of claim 203, wherein the oligo is A-free.

205. The method of claim 173, wherein the oligo is anti-sense to the initiation codon, the coding region or the 5' or 3' intron-exon junctions of a gene encoding an adenosine  $A_1$ ,  $A_{2b}$  or  $A_3$  receptor, and the composition further comprises a surfactant.

206. The method of claim 173, wherein if the oligo contains A, at least one A is substituted with a universal base selected from heteroaromatic bases which bind to a thymidine base but have antagonist activity or less than about 0.3 of the adenosine base agonist activity at the adenosine  $A_1$ ,  $A_{2b}$  or  $A_3$  receptors, or heteroaromatic bases which have no activity or have [an] agonist activity at the adenosine  $A_{2a}$  receptor.

207. The method of claim 206, wherein substantially all As are substituted with universal bases selected from heteroaromatic bases which bind to a thymidine base but have

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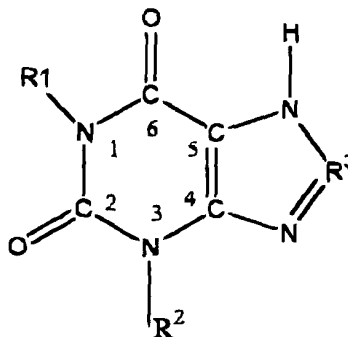
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antagonist activity or less than about 0.3 of the adenosine base agonist activity at the adenosine A<sub>1</sub>, A<sub>2b</sub> or A<sub>3</sub> receptors, heteroaromatic bases which have no activity or have an agonist activity at the adenosine A<sub>2a</sub> receptor.

208. The method of claim 206, wherein the heteroaromatic bases are selected from pyrimidines [and] or purines [, which] that may be substituted by O, halo, NH<sub>2</sub>, SH, SO, SO<sub>2</sub>, SO<sub>3</sub>, COOH branched fused primary secondary amino, alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkoxy, alkenoxy, acyl, cycloacyl, arylacyl, alkynoxy, cycloalkoxy, aroyl, arylthio, arylsulfoxyl, halocycloalkyl, alkylcycloalkyl, alkenylcycloalkyl, alkynylcycloalkyl, haloaryl, alkylaryl, alkenylaryl, alkynylaryl, arylalkyl, arylalkenyl, arylalkynyl, arylcycloalkyl, all of which may be further substituted by O, halo, NH<sub>2</sub>, primary, secondary and tertiary amine, SH, SO, SO<sub>2</sub>, SO<sub>3</sub>, cycloalkyl, heterocycloalkyl or heteroaryl.

209. The method of claim 208, wherein the pyrimidines are substituted at positions 1, 2, 3 and/or 4, and the purines are substituted at positions 1, 2, 3, 4, 7 and/or 8.

210. The method of claim 209, wherein the pyrimidines and purines are selected from theophylline, caffeine, dyphylline, etophylline, acephylline piperazine, bamifylline, enprofylline or xantine having the chemical formula



wherein R<sup>1</sup> and R<sup>2</sup> are independently H, alkyl, alkenyl or alkynyl, and R<sup>3</sup> is H, aryl, dicycloalkyl, dicycloalkenyl, dicycloalkynyl, cycloalkyl, cycloalkenyl, cycloalkynyl, O-cycloalkyl, O-cycloalkenyl, O-cycloalkynyl, NH<sub>2</sub>-alkylamino-ketoxyalkyloxy-aryl or mono or dialkylaminoalkyl-N-alkylamino-SO<sub>2</sub> aryl.

211. The method of claim 206, wherein the universal base [is selected from] comprises 3-nitropyrrole-2'-deoxynucleoside, 5-nitro-indole, 2-deoxyribosyl-(5-nitroindole), 2-deoxyribofuranosyl-(5-nitroindole), 2'-deoxyinosine, 2'-deoxynebularine, 6H, 8H-3,4-dihydropyrimido [4,5-c] oxazine-7-one or 2-amino-6-methoxyaminopurine.

212. The method of claim 173, further comprising methylating at least one cytosine vicinal to a guanosine into a methylated cytosine (mC) if a CpG dinucleotide [if] is present in the

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oligo(s).

213. The method of claim 173, further comprising modifying or substituting at least one mononucleotide of the anti-sense oligo(s) with methylphosphonate, phosphotriester, phosphorothioate, phosphorodithioate, boranophosphate, formacetal, thioformacetal, thioether, carbonate, carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene(methylimino), methyleneoxy (methylimino), 2'-O-methyl, phosphoramidate residues, or combinations thereof.

214. The method of claim 213, wherein substantially all mononucleotides are substituted and/or modified.

215. The method of claim 173, further comprising operatively linking the nucleic acid to an agent [selected from agents] that enhances cell internalization or up-take, or a cell targeting agent[s].

216. The method of claim 215, wherein the cell internalization or up-take enhancing agent is selected from transferrin, asialoglycoprotein or streptavidin.

217. The method of claim 215, wherein the cell targeting agent comprises a vector.

218. The method of claim 217, wherein the vector to which the agent is operatively linked comprises a prokaryotic or eukaryotic vector.

219. The method of claim 173, wherein the nucleic acid comprises an oligo [sequence selected from] of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5 or SEQ ID NO: 7 to SEQ ID NO: 966, or SEQ ID NO: 1, SEQ ID NO:3, SEQ ID NO:5 or SEQ ID NO: 7 to SEQ ID NO: 966, wherein at least one mononucleotide is linked or modified by one or more of phosphorothioate, phosphorodithioate, phosphorotrithioate, methylphosphonate, phosphoramidate, boranophosphate, phosphotriester, formacetal, 2'-O-methyl, thioformacetal, 5'-thioether, carbonate, 5'-N-carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene (methylimino) (MMI) and methyleneoxy (methylimino) (MOMI), terminal 1,3-propanediol, terminal dodecanol, 2'-O-methoxyethyl, C-5-propynyl pyrimidine, C-5 methyl cytidine, C-5 ethynyl pyrimidine, 2'-propoxy, C-18 amine, N3'-P5' phosphoramidates, 3'-alkylamino, 2'-fluoro; 5-fluoro pyrimidine, 5-iodo pyrimidine, 5-bromo pyrimidine, 2'-borano, C-5 hexynyl pyrimidine, 2'-O-(2-methoxy)ethyl, 2'-O-aminopropyl, 5-(phenylethyl) or peptide nucleic acid interbase linkages or conjugated to a polyethylene glycol, cholesterol, cholesteryl, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEASulfate), dehydroepiandrosterone sulfamide (DHEA Sulfatide), ubiquinone (CoQn), dolichol, poly L-lysine, sulfatidic acid or fatty acids.

220. The method of claim 191, wherein the surfactant is selected from polyoxy

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ethylene 23 lauryl ether (Brij 35<sup>®</sup>), t-octyl phenoxy polyethoxy ethanol (Triton X-100<sup>®</sup>), dipalmitoyl phosphatidyl choline (DPPC) and phosphatidyl glycerol (PG) (ALEC<sup>®</sup>), tyloxapol (Exosurf<sup>®</sup>), phospholipids, fatty acids, surfactant-associated proteins (Survanta<sup>®</sup>) or C<sub>22</sub>H<sub>19</sub>C<sub>10</sub> (Atovaquone<sup>®</sup>).

221. The method of claim 173, wherein the hyper-responsiveness to, or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [or] bronchoconstriction, or lung allergy(ies) or inflammation, is associated with asthma or a disease or condition associated with asthma.

222. A diagnostic or therapeutic device adapted for delivering a respirable, inhalable, nasal, intrapulmonary, intraorgan, or intracavitary formulation of particle size about 0.5  $\mu$  to about 500  $\mu$ , the formulation comprising a nucleic acid [which] that comprises at least one oligonucleotide (oligo) effective for diagnosing or treating hyper-responsiveness to, or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, [or] bronchoconstriction, asthma, or lung allergy(ies) or inflammation, or a disease or condition associated with either of them, the oligo being anti-sense to the initiation codon, the coding region or the 5' or 3' intron-exon junctions of a gene encoding a protein associated with hyper-responsiveness to, or increased levels of, adenosine or A<sub>1</sub>, A<sub>2a</sub>, A<sub>2b</sub> or A<sub>3</sub> adenosine receptors, bronchoconstriction, asthma, or lung allergy(ies) or inflammation, or being anti-sense to the corresponding mRNA; the nucleic acid comprising one or more oligo(s), their mixtures, or their pharmaceutically or veterinarily acceptable salts.

223. The device of claim 222, comprising a nebulizer adapted for delivering single metered doses of the formulation as a solid powdered or liquid aerosol or spray of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ .

224. The device of claim 222, which comprises an insufflator adapted for receiving and piercing or opening a capsule(s) or cartridge(s) and for producing a solid powdered or liquid aerosol or spray of particle size about 0.5 $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ , and wherein the formulation is provided separately in a piercable or openable capsule(s) or cartridge(s) as a nasal, inhalable, respirable, intrapulmonary, intracavitary or intraorgan formulation of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ .

225. The device of claim 222, which comprises a pressurized [inhalator] inhaler that delivers a solid powdered or liquid aerosol or spray formulation of particle size about 0.5  $\mu$  to about 10  $\mu$  or about 10  $\mu$  to about 500  $\mu$ ; [and] wherein the formulation comprises a suspension, solution, emulsion or dry powder aerosol or spray formulation of the nucleic acid of particle size about 0.05  $\mu$  to about 50  $\mu$  or about 10  $\mu$  to about 500  $\mu$ .



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226. The pressurized [inhalator] inhaler of claim 225 further comprising, in [a] separate containers, a propellant and pressurized means for delivery[,] adapted for delivering a solid powdered or liquid aerosol or spray, and instructions for loading into [the] the delivery device the inhalable, respirable, nasal, intracavitary, intraorgan or intrapulmonary formulation, and joining the device with the propellant and the pressurized delivery means.

227. The pressurized [inhalator] inhaler of claim 225, further comprising a propellant and propellant delivery means, wherein the pressurized [inhalator] inhaler delivers the formulation as a liquid or solid powdered aerosol or spray.

228. The device of claim 222, which is adapted for receiving and piercing or opening a capsule(s) or cartridge(s), and wherein the formulation is provided separately in a capsule(s) or cartridge(s).

229. The kit of claim 164, wherein the oligo is anti-sense to the initiation codon, the coding region or the 5' or 3' region of a gene encoding a polypeptide selected from an adenosine A<sub>1</sub> receptor, adenosine A<sub>2a</sub> receptor, adenosine A<sub>2b</sub> receptor, or adenosine A<sub>3</sub> receptor.

230. The kit of claim 229, for diagnosis or treatment of sepsis, pulmonary vasoconstriction, inflammation, allergies, asthma, impeded respiration, respiratory distress syndrome (RDS), acute respiratory distress syndrome (ARDS), pain, cystic fibrosis (CF), pulmonary hypertension, pulmonary vasoconstriction, emphysema or chronic obstructive pulmonary disease (COPD).

231. The kit of claim 164, wherein the nucleic acid comprises an oligo [sequence selected from] of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5 or SEQ ID NO: 7 to SEQ ID NO: 996, or SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5 or SEQ ID NO: 7 to SEQ ID NO: 996, wherein at least one mononucleotide is linked or modified by one or more of phosphorothioate, phosphorodithioate, phosphorotrithioate, methylphosphonate, phosphoramidate, boranophosphate, phosphotriester, formacetal, 2'-O-methyl, thioformacetal, 5'-thioether, carbonate, 5'-N-carbamate, sulfate, sulfonate, sulfamate, sulfonamide, sulfone, sulfite, sulfoxide, sulfide, hydroxylamine, methylene (methylimino) (MMI) and methyleneoxy (methylimino) (MOMI), terminal 1,3-propanediol, terminal dodecanol, 2'-O-methoxyethyl, C-5-propynyl pyrimidine, C-5 methyl cytidine, C-5 ethynyl pyrimidine, 2'-propoxy, C-18 amine, N3'-P5' phosphoramidates, 3'-alkylamino, 2'-fluoro; 5-fluoro pyrimidine, 5-iodo pyrimidine, 5-bromo pyrimidine, 2'-borano, C-5 hexynyl pyrimidine, 2'-O-(2-methoxy)ethyl, 2'-O-aminopropyl, 5-(phenylethyl) or peptide nucleic acid interbase linkages or conjugated to a polyethylene glycol, cholesterol, cholesteryl, dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEA Sulfate), dehydroepiandrosterone sulfatide (DHEA Sulfatide), ubiquinone (CoQn),

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dolichol, poly L-lysine, sulfatidic acid or fatty acids.

232. The composition of claim 108, which comprises particle sizes of about  $0.5\mu$  to about  $10\mu$  or about  $10\mu$  to about  $500\mu$ .

233. The nucleic acid of claim 108, which is operatively linked to a vector.

234. A single cell, comprising the nucleic acid of claim 233.

S:\legal\00672\Claims 01-7-12 (marked)